THE ASTROLABE OF REGIOMONTANUS.

BY CHARLES A. BRASSLER.

The subject of our present article, which we shall endeavor to describe as well as illustrate, is one of those intensely interesting instruments used by our forefathers for taking the altitude of the sun and stars at sea. It is the astrolabe of Regiomontanus, and it may still be seen in the Germanic Museum at Nuremberg. Who was this Regiomontanus? Johannes Müller by name, he was born at Königsberg in 1436, and he became an astronomer and mathematician of repute, in fact one of the greatest astronomers of the time, and like the great men of the day he affected the name of his native city, conferring thereby fame upon his birthplace, and assumed, therefore, the appellation *Regiomontanus*, meaning a Königsberger.

In connection with Bernhard Walther he built, in 1472, the first German observatory, where he conducted a series of the most exact observations with the beautiful instruments of his own invention and make, to which this astrolabe also belonged. A number of instruments of the kind that were employed upon shipboard sprang from his fertile brain; and it is certain that Columbus made use of the astronomical tables, compiled by Regiomontanus, for the determination of his whereabouts during his voyages and they must have played an important part in the later discoveries of the bold Genoese. It was Regiomontanus, too, who first studied the distances and motion of the comets.

Before the telescope was discovered, and it only came into use in 1610, all the practical astronomers busied themselves exclusively with measurements. To-day the telescope and the measuring instrument are combined and in this form the most exact observations of the stars are made possible; then the so-called *diopters* were employed and they had to be pointed at the stars. These were either tubes having small openings in either end through which one could see the star, or rulers of wood or metal, that carried at their lower end a perforated board and at the upper end a similar board used as a sight.

This method of observation, far from complete, required large and carefully-divided circles, that is, quarter circles or quadrants wherewith the height of the stars above the horizon or the distance between two stars could be measured; for the larger these quadrants the farther apart were the divisions representing degrees and as a consequence the more exactly was the operator enabled to read them off. Tycho Brahe, the great Danish astronomer of the sixteenth century, had worked with one of these large measuring instruments. According to Bürgel he had a huge quadrant let into a wall, called a wall quadrant, with a radius of more than three meters; the whole circuit of this immense instrument was nigh on to twenty meters. He was successful in obtaining very exact results with this. The astroblades were, however, much smaller, and also the results were greatly inferior to those obtained with the huge quadrants and octants. Indeed, they were never intended for the finest measurements. Since they were light and easily carried about, being from twenty to thirty centimeters in diameter, they were peculiarly adapted for seamen and travelers.

A clever observer such as Regiomontanus might obtain very exact measurements with a carefully-constructed astrolabe such as the one we show in the cut. The astrolabe was a sort of universal instrument. Not only could the height of a star above the horizon be measured by it and its distance from the zenith, but also many measurements, particularly the position of the sun, from which the local time and also the sidereal time could be obtained. When in use the astrolabe was suspended by the ring at the top or held freely in the hand so that the white line we see drawn across the face of the disk should fall exactly upon the horizon and in that way form the artificial horizon, while the vertical lines should be perpendicular to it. From this it is easy to see that an imperfect suspension of the instrument would lead to grave faults in the calculations.

ASTROLABE OF REGIOMONTANUS.

The large disk, upon which the divisions of degrees are engraved, was made of metal; so also were all the other parts most carefully worked out of metal. *Mater* is the name given to the large disk divided into degrees. Inside of this is set a second metal plate, the so-called planisphere, and we can recognize it by the engraved net work. This net work comprises the degree-divisions of the heavens carried out upon a plane surface, hence the name (*sphaera*, the Latin word for a sphere, and *planum*, signifying a plane).

Above the planisphere lies the neatly cut out and decorated "rete" carrying upon its circular interior the constellations of the ecliptic. The pole of the ecliptic and the positions of some of the stars are also given.

Turning upon the axis of the whole we finally find the *diopter rule*, called also the "Alhidad rule," the pointed ends of which serve as indicators for reading off the degrees on the outer circle. Slightly removed from the ends and approaching the center we see the little sighting boards with their holes for vision. If now we desire to find the local time we must proceed as follows: Hang up the astrolabe so that the plane of the mater coincides exactly with the plane of the sun's rays. Then, looking through the two holes in the diopter rule, turn it until the sun can be seen. Upon the extreme circle the height of the sun may now be read in degrees at the point of the diopter nearest the eye.

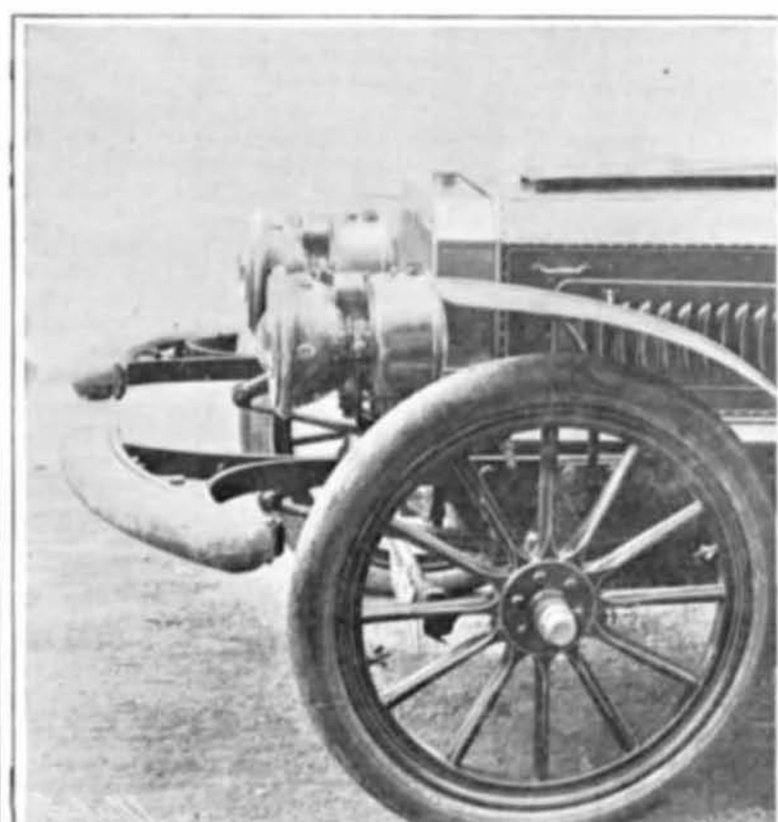
Now look up in the tables the position of the sun, the sun's longitude for this day in the ecliptic, and, by turning the "rete," bring the point on the ecliptic of the sun given for this day into coincidence with the height of the sun as measured by the diopter rule on the outer scale. A special pointer on the "rete" will now indicate a figure engraved upon the disk, which will correspond with the sun's time at the moment of the observation. The astrolabe in its positive form was invented by Hipparchus in the second century before Christ and until the beginning of the eighteenth century it was occasionally used, even though it did not give very exact results.

A SAFETY BUFFER FOR AUTOMOBILES.

Collisions by an automobile, either with stationary or moving objects, nearly always result in a certain amount of damage being inflicted upon the motor vehicle. As a rule it is the front lamps, mudguards, and, occasionally, the front wheels which suffer. With the object of minimizing this danger, and also for protecting the obstacles with which the car happens to collide, a novel safety buffer has been introduced by the Simms Motor Manufacturing Company, of London. As will be seen from the accompanying illustration, the device consists of two short rim segments attached either to the front or side members of the chassis of the automobile. To this rim is fixed a short length of pneumatic cushion, fully inflated. Being placed well in advance of the front of the vehicle, the lamps, mudguards, and wheels are adequately protected, and the curved nature of the buffer tends to transform the impact into a glancing blow. Owing to the bracket carrying the buffer being of stout construction and fashioned in the form of a spring, there is little possibility of the buffer collapsing or buckling by the force of the impact with another object.

The device has been subjected to several tests when fitted to a 20-horse-power car. The working of the buffer is well shown in the accompanying illustration.

Car Equipped with Buffer Striking a Delivery Tricycle.



A Near View of the Buffer.

A NOVEL PNEUMATIC SAFETY BUFFER FOR AUTOMOBILES.

If the obstacle is of a light nature, it is deflected and thrown out of the track of the car. On the other hand, should the collision be with a stationary object, the pneumatic buffer serves to take up the force of the shock and will also deflect the trajectory of the car to which it is fitted.

The application of this safety device is also being extended to power boats, for which it is well adapted. It is more efficient and safer than the type of fender ordinarily employed, and the effect of a collision with another boat would be considerably reduced in character. The danger of ramming is entirely obviated owing to the broad surface offered by the buffers.

THE ELECTROLYTIC PRODUCTION OF HYDROGEN AND OXYGEN FOR WELDING PURPOSES

BY DR. ALFRED GRADENWITZ.

Though the oxygen-hydrogen process of welding has so far given rather satisfactory results and should seem to be destined to replace the expensive familiar riveting and welding methods, the price of the oxygen and hydrogen gases, as produced by chemical methods, has been a serious drawback to its general adoption. As gases were supplied in the compressed state in steel bottles, which after being emptied had to be returned, the considerable transporting cost and renting fees were added to their own high price, due to the compression of the gases.

Of late years there have, however, been designed a number of outfits for the electrolytical production of the oxygen and hydrogen gases by the decomposition of water, two of which have proved fully satisfactory in working, namely, first, the Schuckert apparatus, and second, the Oerlikon electrolyzer. The latter, which has been described in detail by the writer in the Scientific American, No. 27, vol. 91, is being constructed also by the Siemens & Halske Company, and consists of a number of separate chambers, containing plate electrodes of cast iron, which are separated from one another by diaphragms. The gases set free at the electrodes are led through various pipe systems to separators, to be completely freed from any water, which flows back again into the electrolyzer.

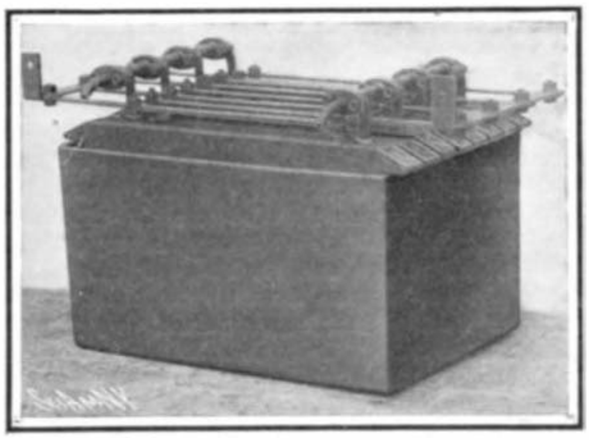
In the following we wish to dwell at some length on the Schuckert type of apparatus, which is now being constructed by the Electrical Company, formerly Schuckert & Co., of Nuremberg, Germany.

These electrolyzers, photographs of which are reproduced herewith, are exceedingly safe to operate, on account of their simplicity of design. All parts of the apparatus are readily accessible, there is no material superintendence required, while a cleaning made once or twice per year is quite sufficient to keep the apparatus in working order. The electrolyzer has been designed especially with a view to its use for welding purposes, supplying the gas immediately under the pressure required for welding, so as to necessitate no compression. As gas is derived from the gasometers for the welding, the latter are being filled up by the electrolyzers, the generation of the gases occurring with perfect continuity.

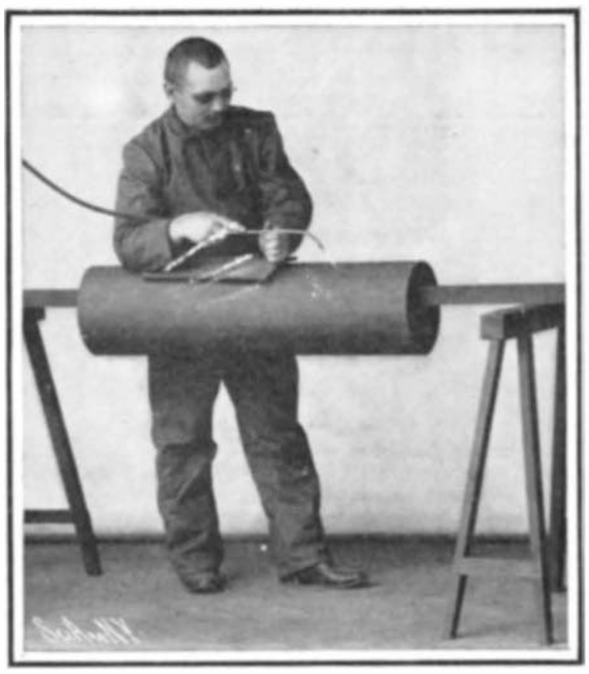
The apparatus, as can be seen above, consists of a cast iron tank, containing a number of cells, where the gases evolved on the electrodes are allowed to accumulate. Apart from the copper conductors, for supplying the current and from the insulation material, the apparatus is made up of iron throughout. A solution of 20 per cent caustic potash in water is used as electrolyte. A tension of from 2.3 to 3 volts is required for the operation of these apparatus, which are connected up either in series or in parallel, a proper amount of distilled water being filled in from time to time during operation. This is the whole of the superintendence required, in fact, no more than is necessary in the case of a storage battery of the same size.

The apparatus are protected against heat radiation by a sand layer about five centimeters in thickness, so as to maintain in the electrolyte a temperature of 70 to 75 deg. C., which is the most favorable, requiring the smallest potential difference for the decomposition of the electrolytic bath. The oxygen and hydrogen evolved by electrolysis are conducted each to a gasometer through separate pipes and thence to the neighborhood of the working place, there to be united in a burner, as they arrive in two separate India rubber tubes, and to be burned in a pointed flame. This flame is carried over the sheets to be welded (which are applied to one another at an obtuse angle) like an ordinary soldering flame, but without the agency of any special soldering matter, when the surfaces applied to one another become perfectly melted together. In order to give an idea of the cost of operation of the electrolytic process as compared with the chemical method, it should be mentioned that whereas "chemical" hydrogen as purchased in bottles will cost between 1.20 marks and 2 marks per cubic meter, and one cubic meter of oxygen works out at about 2.50 marks to 3.50 marks (apart from the cost of transport and the renting fees) the aggregate cost of producing one cubic meter of hydrogen and one-half cubic meter of oxygen by the electrolytic decomposition of water in Schuckert electrolyzers (supposing an average price of electric power) will range between 60 and 75 pfennigs, including interest and amortization of the whole plant. Under normal conditions, the cost of producing the gas mixture necessary for the welding of 1 meter of sheet iron 3 millimeters in thickness, will be about 15 to 20 pfennigs and will be effected readily in ten to fifteen minutes.

The gases supplied by the electrolyzer are of a high purity and perfectly safe against explosion; their efficiency is quite satisfactory. The operation can be discontinued and taken up again at any time without interfering with the satisfactory working of the apparatus.



Apparatus for the Electrolytic Production of Oxygen and Hydrogen.



How the Oxy-hydrogen Flame is Used in Welding.

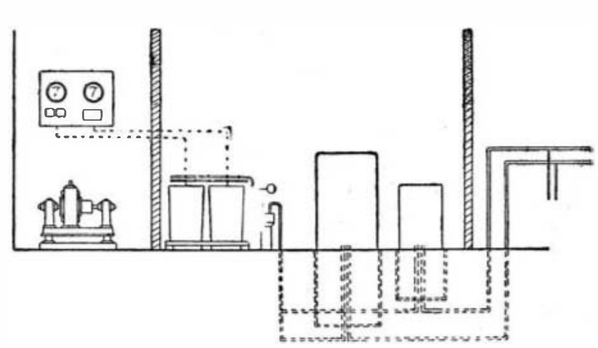
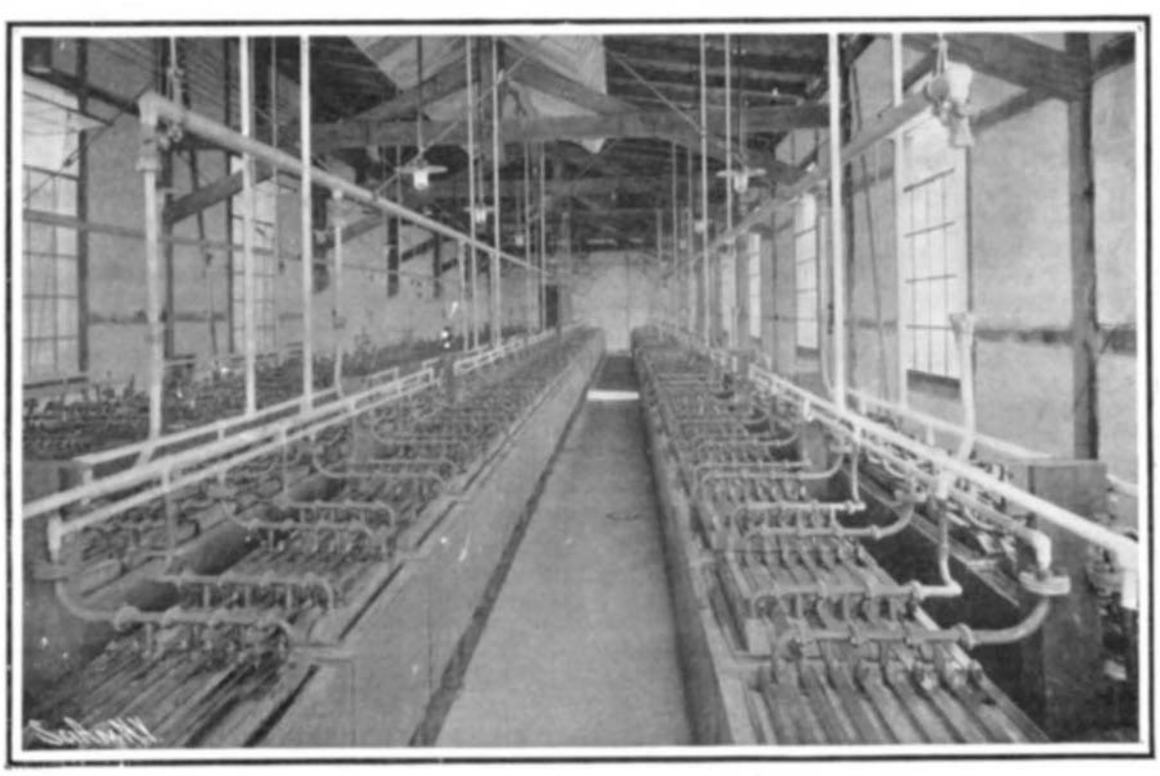


Diagram of the Plant for the Electrolytic Production of Oxygen and Hydrogen.



Large Plant for Producing by Electrolysis 42,378 Cubic Feet of Hydrogen and 21,089 Cubic Feet of Oxygen in 24 Hours.

THE ELECTROLYTIC PRODUCTION OF HYDROGEN AND OXYGEN FOR WELDING PURPOSES.

Electricity in Egypt.

The German Consul at Alexandria gives some information as to the use of electricity for various purposes in Egypt. In Cairo we find that lighting current is generated by a station which the gas company controls, but the public lighting is not developed as yet and only private lighting is operated at present. A tramway system is working in the city. It is owned by a Brussels company. Alexandria is using current for private lighting, but, like Cairo, has no public system. The tramway lines are controlled by an Egyptian company. To connect Alexandria with its eastern suburbs, a concession has been granted to the Alexandria and Ramleh Railway, which has lately adopted electric traction on the lines. The same English company are now operating the city tramway lines. Port Said now has an electric lighting system, which is newly installed, but there are no electric tramways. At Mansourah, the public and private lighting is conceded to an English company for twenty years, dating from 1899. At Suez the concession for the electric lighting in the town and also at Port Tewfik was given to H. Beyts & Co. in 1902, but has now passed into the hands of the Ismailiah Electric Company. It seems that gas engines are to be used to a considerable extent in Egypt in the future. Motive power is employed almost exclusively for irrigation. The most common type of machine is the portable locomotive, of English construction, but it takes a great quantity of coal, and this is very expensive in a country like Egypt. It seems that these machines can be very advantageously replaced by gas engines, which are much more economical, especially the latest forms, which are well adapted for use here, and consume only 1.3 pound of anthracite coal per horse-power-hour. Transport of force would be a great advantage in Egypt for operating the small irrigating machines. It will no doubt come into use soon, and a start has been made by a French engineer. He employs the engines of a cotton factory which is not always running, to operate dynamos and send current for working electric pumps to carry out the irrigation. On one plantation a Siemens-Schuckert electric plant gives power for motors. Prince Djemil Tussum has also adopted a German electric station on his property for the same purpose. It will be remembered that the gates of the celebrated Asswan dam are operated by Siemens-Schuckert electric motors. There is some question of using the cataracts of the Nile as a source of hydraulic power to operate electric plants and distribute current throughout a region which is now a desert, but which would be flourishing could the Nile water be taken through it. Thus the river would give the irrigation water and also the motive power. But this project is one which remains for the future to solve.

The Largest Flower.

Sumatra grows the largest flower in the world. It measures a yard and three inches across, and its cup will hold six quarts of water. *Rafflesia Arnoldii* is its name.—Philadelphia Bulletin.